

**What is Claimed is:**

1. A method for selectively etching a sacrificial light absorbing material over a dielectric material on a substrate, comprising:

providing a substrate comprising a sacrificial light absorbing material and a dielectric material to a process chamber;

supplying to the process chamber a process gas mixture comprising a hydrofluorocarbon gas, a nitrogen-containing gas, an oxygen-containing gas and an inert gas; and

dissociating and ionizing the process gas mixture to etch the sacrificial light absorbing material.

2. The method of claim 1 wherein the process gas mixture further comprises at least one gas selected from a group consisting of hydrogen-containing gas and a fluorine-rich fluorocarbon gas.

3. The method of claim 1 wherein the hydrofluorocarbon gas is  $\text{CH}_3\text{F}$ , the flow rate is between about 5 sccm to about 500 sccm and the flow ratio of the hydrofluorocarbon gas to the oxygen-containing gas is between about 1 to about 20.

4. The method of claim 2 wherein the hydrogen-containing gas is  $\text{H}_2$ , the flow rate is between about 0 sccm to about 500 sccm and the flow ratio of the hydrogen-containing gas to the oxygen-containing gas is between about 0 to about 5.

5. The method of claim 2 wherein the fluorine-rich fluorocarbon gas is  $\text{CF}_4$ , the flow rate is between about 0 sccm to about 1000 sccm and the flow ratio of the fluorine-rich fluorocarbon gas to the oxygen-containing gas is between about 0 to about 5.

6. The method of claim 1 wherein the nitrogen-containing gas is nitrogen, the flow rate is between about 5 sccm to about 500 sccm and the flow ratio of the nitrogen-containing gas to the oxygen-containing gas is between about 1 to about 10.

7. The method of claim 1 wherein the oxygen-containing gas is oxygen and the flow rate is between about 5 sccm to about 500 sccm.
8. The method of claim 1 wherein the inert gas is argon, the flow rate is between about 20 sccm to about 2000 sccm and the flow ratio of the inert gas to the oxygen-containing gas is between about 1 to about 30.
9. The method of claim 1 wherein the sacrificial light absorbing material is TESAC dyed methylsiloxane polymer.
10. The method of claim 1 wherein the sacrificial light absorbing material is formed atop a dielectric material, where the dielectric material is a carbon doped oxide with 1 to 50% atomic weight carbon content.
11. The method of claim 1 wherein the bias power is between 0 watts to 1000 watts.
12. The method of claim 1 wherein the source power is between 50 to 5000 watts.
13. The method of claim 1 wherein the cathode temperature is maintained between  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$ .
14. The method of claim 1 wherein the process pressure is between 1 mTorr to about 1 Torr.
15. The method of claim 1 wherein the etch selectivity of the sacrificial light absorbing material over the dielectric material is higher than 5:1.
16. The method of claim 1 wherein the etch selectivity of the sacrificial light absorbing material over the dielectric material is higher than 10:1.
17. The method of claim 1 wherein the etch rate of the sacrificial absorbing material is greater than 200 angstrom per minute.

18. The method of claim 18 wherein the etch rate of the sacrificial absorbing material is greater than 500 angstrom per minute.

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19. A method for selectively etching a photoresist material over a dielectric material and selectively etching a sacrificial light absorbing material over a dielectric material on a substrate, comprising:

providing a substrate comprising comprising a photoresist material, a sacrificial light absorbing material, and a dielectric material;

supplying to the process chamber a process gas mixture comprising a hydrofluorocarbon gas, a nitrogen-containing gas, an oxygen-containing gas and an inert gas; and

dissociating and ionizing the process gas mixture to remove the photoresist material and the sacrificial light absorbing material.

20. The method of claim 19 wherein the process gas mixture further comprises at least one gas selected from a group consisting of hydrogen-containing gas and a fluorine-rich fluorocarbon gas.

21. The method of claim 19 wherein the hydrofluorocarbon gas is  $\text{CH}_3\text{F}$ , the flow rate is between about 5 sccm to about 500 sccm and the flow ratio of the hydrofluorocarbon gas to the oxygen-containing gas is between about 1 to about 20.

22. The method of claim 20 wherein the hydrogen-containing gas is  $\text{H}_2$ , the flow rate is between about 0 sccm to about 500 sccm and the flow ratio of the hydrogen-containing gas to the oxygen-containing gas is between about 0 to about 5.

23. The method of claim 20 wherein the fluorine-rich fluorocarbon gas is  $\text{CF}_4$ , the flow rate is between about 0 sccm to about 1000 sccm and the flow ratio of the fluorine-rich fluorocarbon gas to the oxygen-containing gas is between about 0 to about 5.

24. The method of claim 19 wherein the nitrogen-containing gas flow rate is between about 5 sccm to about 500 sccm and the flow ratio of the nitrogen gas to the oxygen-containing gas is between about 1 to about 10.

25. The method of claim 19 wherein the oxygen-containing gas is oxygen and the flow rate is between about 5 sccm to about 500 sccm.

26. The method of claim 19 wherein the inert gas is argon, the flow rate is between about 20 sccm to about 2000 sccm and the flow ratio of the inert gas to the oxygen-containing gas is between about 1 to about 30.

27. The method of claim 19 wherein the sacrificial light absorbing material is TESAC dyed methylsiloxane polymer.

28. The method of claim 19 wherein the photoresist is a deep ultraviolet (DUV) photoresist.

29. The method of claim 19 wherein the sacrificial light absorbing material is formed atop a dielectric material, where the dielectric material is a carbon doped oxide with 1 to 50% atomic weight carbon content.

30. The method of claim 19, wherein the photoresist is formed atop the sacrificial light absorbing material.

31. The method of claim 19 wherein the bias power is between 0 watts to 1000 watts.

32. The method of claim 19 wherein the source power is between 50 to 5000 watts.

33. The plasma etch process of claim 19 wherein the cathode temperature is maintained between  $-20^{\circ}\text{C}$  to  $80^{\circ}\text{C}$ .

34. The method of claim 19 wherein the process pressure is between 1 mTorr to about 1 Torr.

35. The method of claim 19 wherein the etch selectivity of the sacrificial light absorbing material over the dielectric material is higher than 5:1 and the etch selectivity of the photoresist material over the dielectric material is higher than 5:1.

36. The method of claim 19 wherein the etch selectivity of the sacrificial light absorbing material over the dielectric material is higher than 10:1 the etch selectivity of the photoresist material over the dielectric material is higher than 10:1.

37. The method of claim 19 wherein the etch rates of the sacrificial absorbing material and the photoresist are greater than 200 angstrom per minute.

38. The method of claim 37 wherein the etch rates of the sacrificial absorbing material and the photoresist are greater than 500 angstrom per minute.

39. A plasma etch process for selectively etching a sacrificial light absorbing material over a dielectric material on a substrate, comprising:

providing a substrate comprising a sacrificial light absorbing material and a dielectric material to a process chamber;

supplying to the process chamber a process gas mixture comprising a  $\text{CH}_3\text{F}$  gas flow rate between about 5 sccm to about 500 sccm, a nitrogen gas flow rate between about 5 sccm to about 500 sccm, an oxygen gas flow rate between about 5 sccm to about 500 sccm, an argon gas flow rate between about 20 sccm to about 2000 sccm, the ratio of  $\text{CH}_3\text{F}$  flow rate to oxygen flow rate is between about 1 to about 20, the ratio of nitrogen flow rate to oxygen flow rate is between about 1 to about 10, and the ratio of Ar flow rate to oxygen flow rate is between about 1 to about 30;

supplying the process chamber a bias power between about 0 watts to 1000 watts and a source power between about 50 watts to about 5000 watts,

maintaining the cathode temperature between about  $-20^\circ\text{C}$  to about  $80^\circ\text{C}$  and chamber pressure between about 1 mTorr to about 1 Torr; and

dissociating and ionizing the process gas mixture to etch the photoresist and the sacrificial light absorbing material.

40. The method of claim 39 wherein the process gas mixture further comprises at least one gas selected from the group consisting of hydrogen ( $H_2$ ) and fluorocarbon ( $CF_4$ ), wherein an  $H_2$  gas flow rate is between about 0 sccm and about 500 sccm, an  $CF_4$  gas flow rate is between about 0 sccm to about 1000 sccm, the ratio of  $H_2$  flow rate to oxygen flow rate is between 0 to about 5, and the ratio of  $CF_4$  flow rate to  $O_2$  flow rate is between about 0 to about 5.